# Calculus 1 Workbook

## Continuity

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MATH

## REMOVABLE DISCONTINUITIES

■ 1. Redefine the function as a continuous piecewise function.

$$f(x) = \frac{x^2 - 6x - 27}{x + 3}$$

■ 2. Redefine the function as a continuous piecewise function.

$$g(x) = \frac{\sin x}{x}$$

■ 3. What are the removable discontinuities of the function?

$$h(x) = \frac{x^4 - 5x^2 + 4}{x^2 - 1}$$

■ 4. Identify the non-removable discontinuities of the function.

$$k(x) = \frac{x^3 + 3x^2 - 25x - 75}{x^2 + x - 12}$$

■ 5. What is the set of removable discontinuities of the function?

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$$j(\theta) = \frac{\cos^2\theta \cdot \sin^2\theta}{\tan^2\theta}$$

■ 6. Redefine the function as a continuous piecewise function.

$$g(x) = \frac{x^3 - 8}{x - 2}$$

■ 7. Identify the non-removable discontinuity in the function.

$$k(x) = \begin{cases} x & x < 0 \\ 2 & x = 0 \\ x + 3 & x > 0 \end{cases}$$

■ 8. What is the removable discontinuity in the function?

$$f(x) = \frac{x^3 + 27}{x + 3}$$

■ 9. Identify the removable discontinuities in the function.

$$k(x) = \frac{x^4 - 2x^3 - 16x^2 + 2x + 15}{x^2 - 2x - 15}$$

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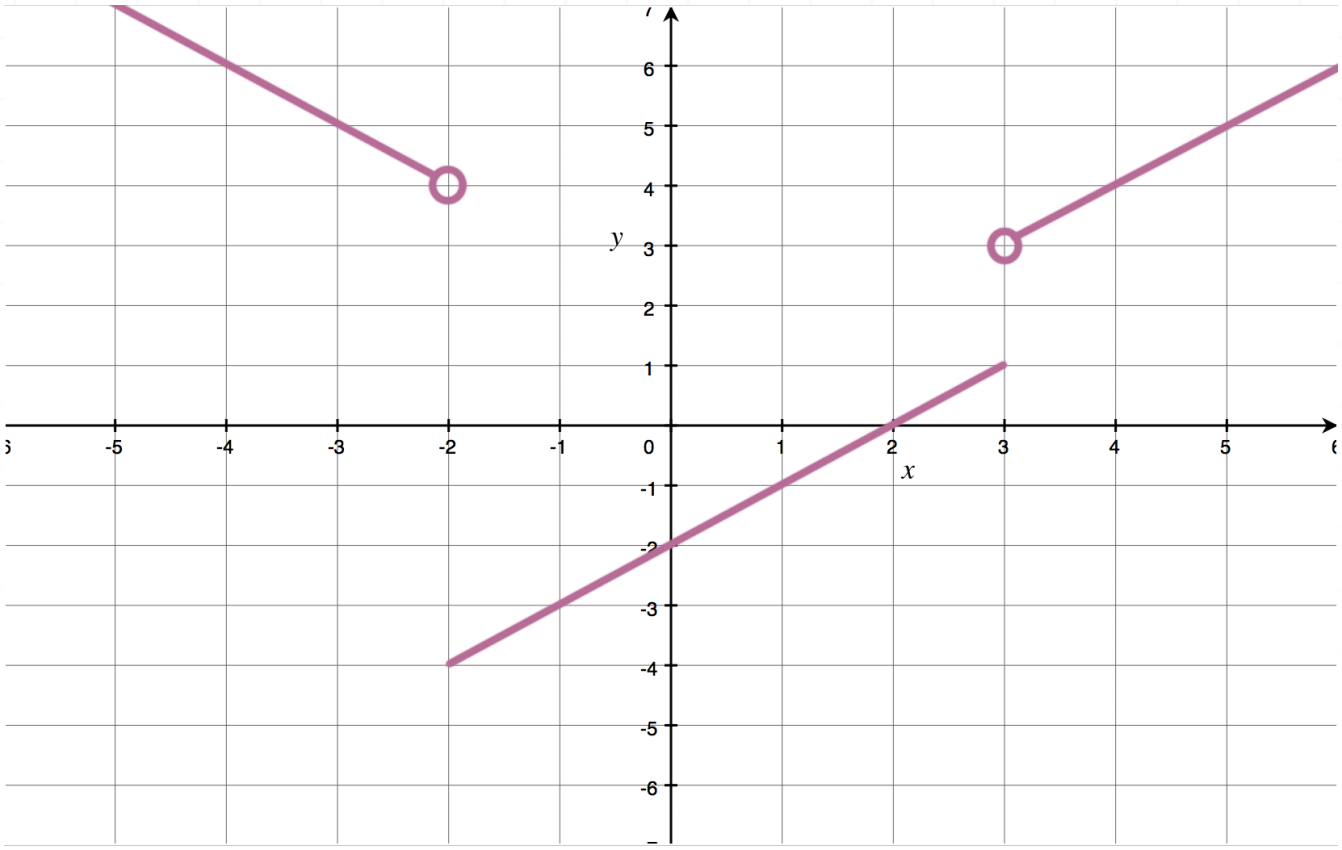
## JUMP DISCONTINUITIES

■ 1. What are the $x$-values where the graph of $f(x)$, shown below, has jump discontinuities?




■ 2. Where are the jump discontinuities in the graph of the function?

$$h(x) = \begin{cases} -\frac{1}{3}x^2 + 2 & x < 0 \\ 3 & 0 \leq x \leq 1 \\ \frac{1}{3}x^2 + 4 & x > 1 \end{cases}$$

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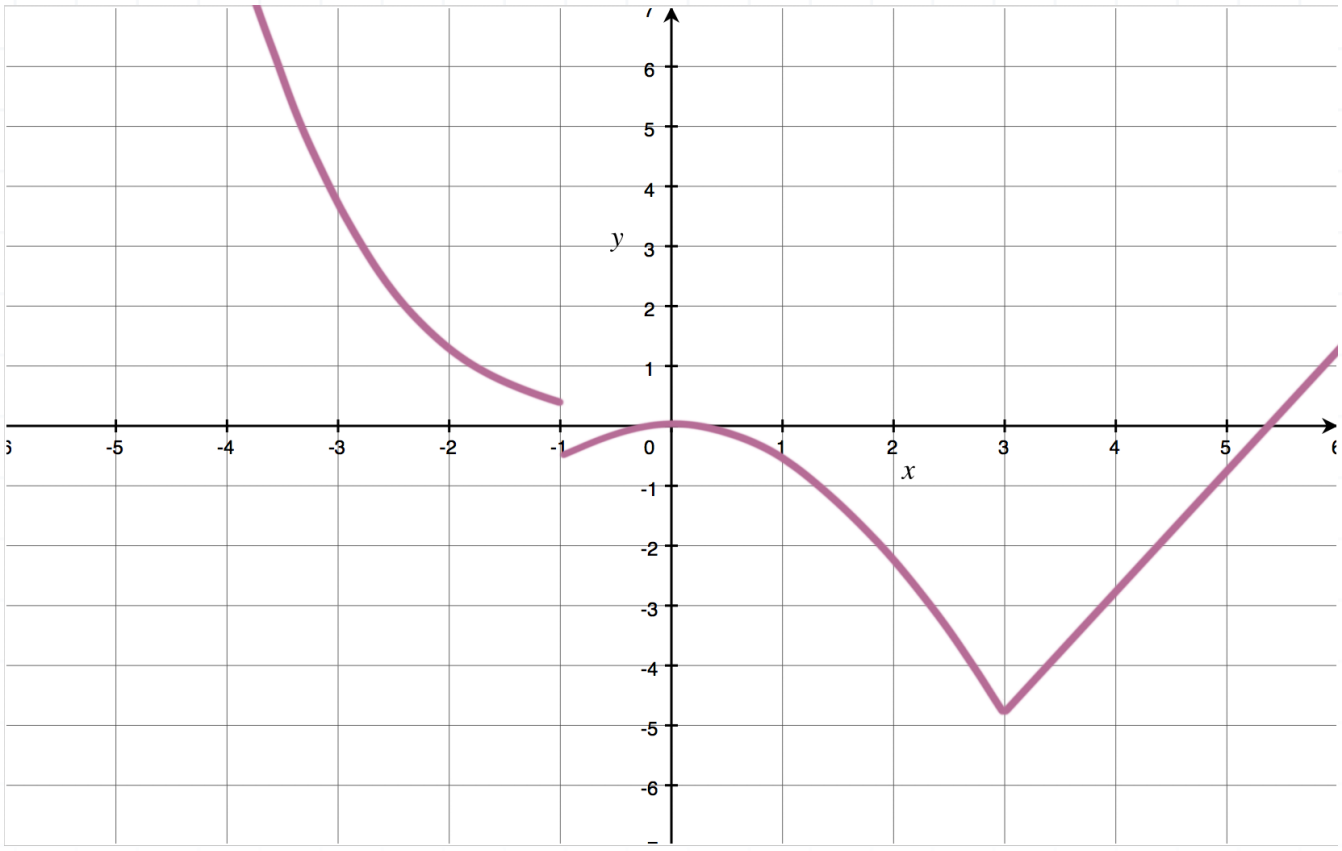
■ 3. What are the $x$-values where the graph of $g(x)$ has jump discontinuities?




■ 4. What are the $x$-values where the graph of $f(x)$, shown below, has jump discontinuities?

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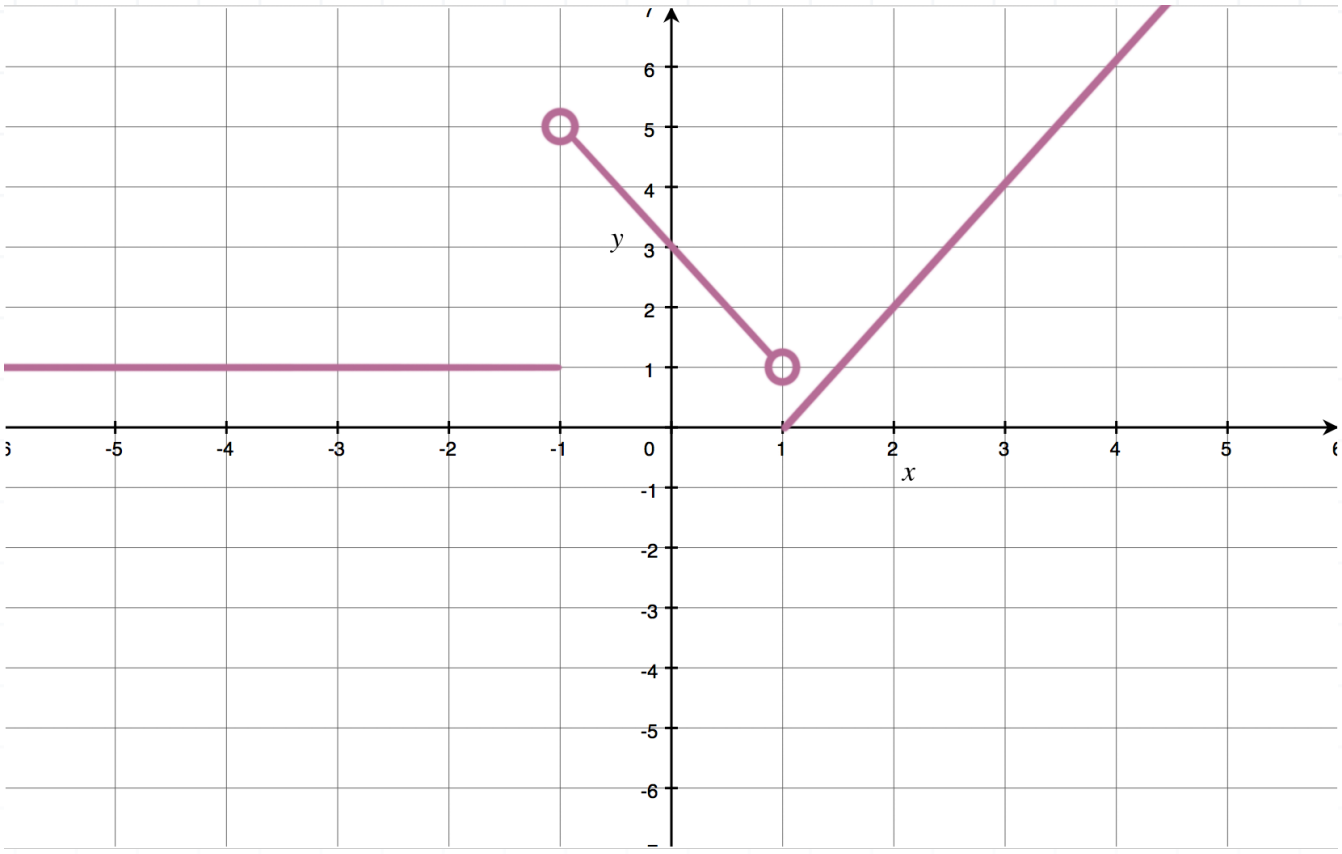
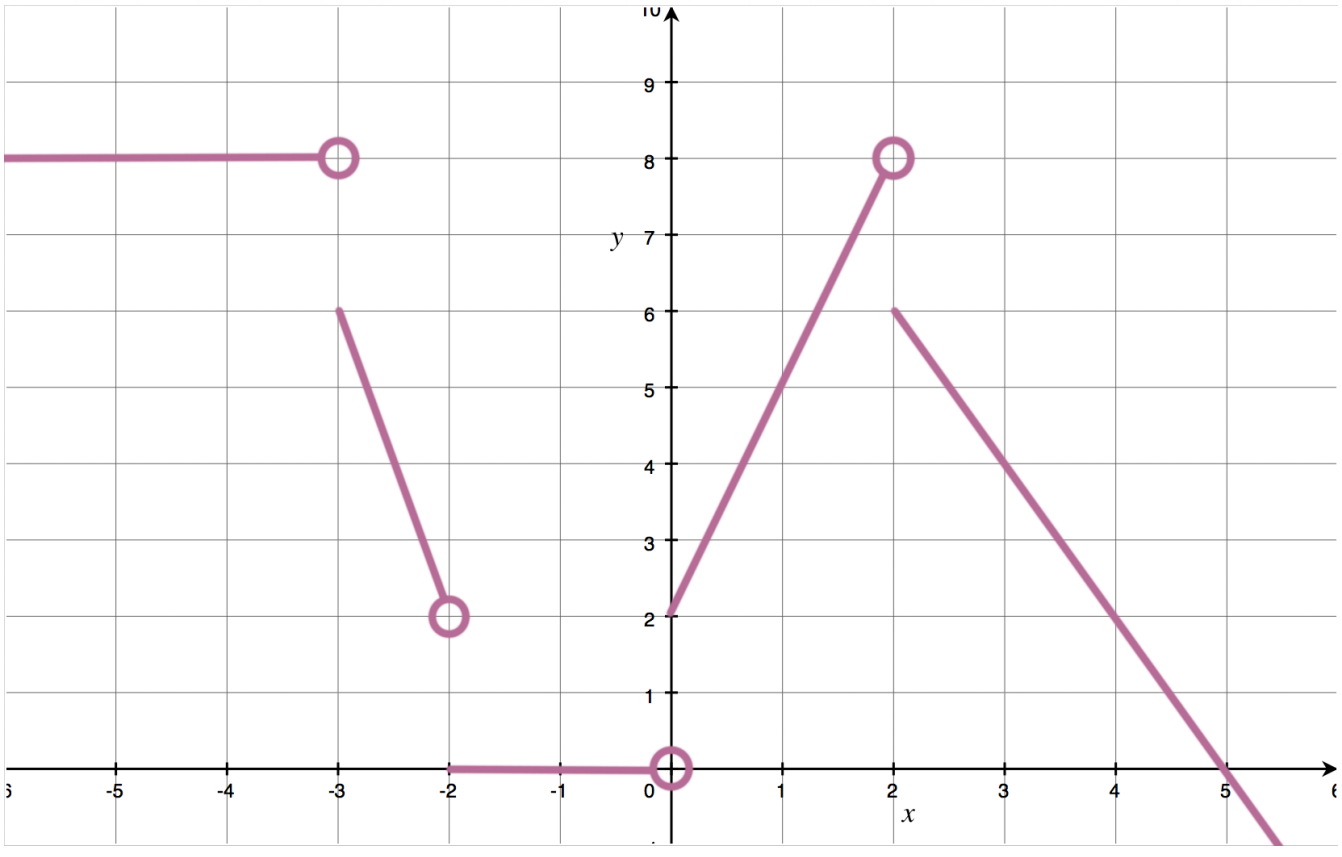



5. Where are the jump discontinuities in the graph of the function shown below?

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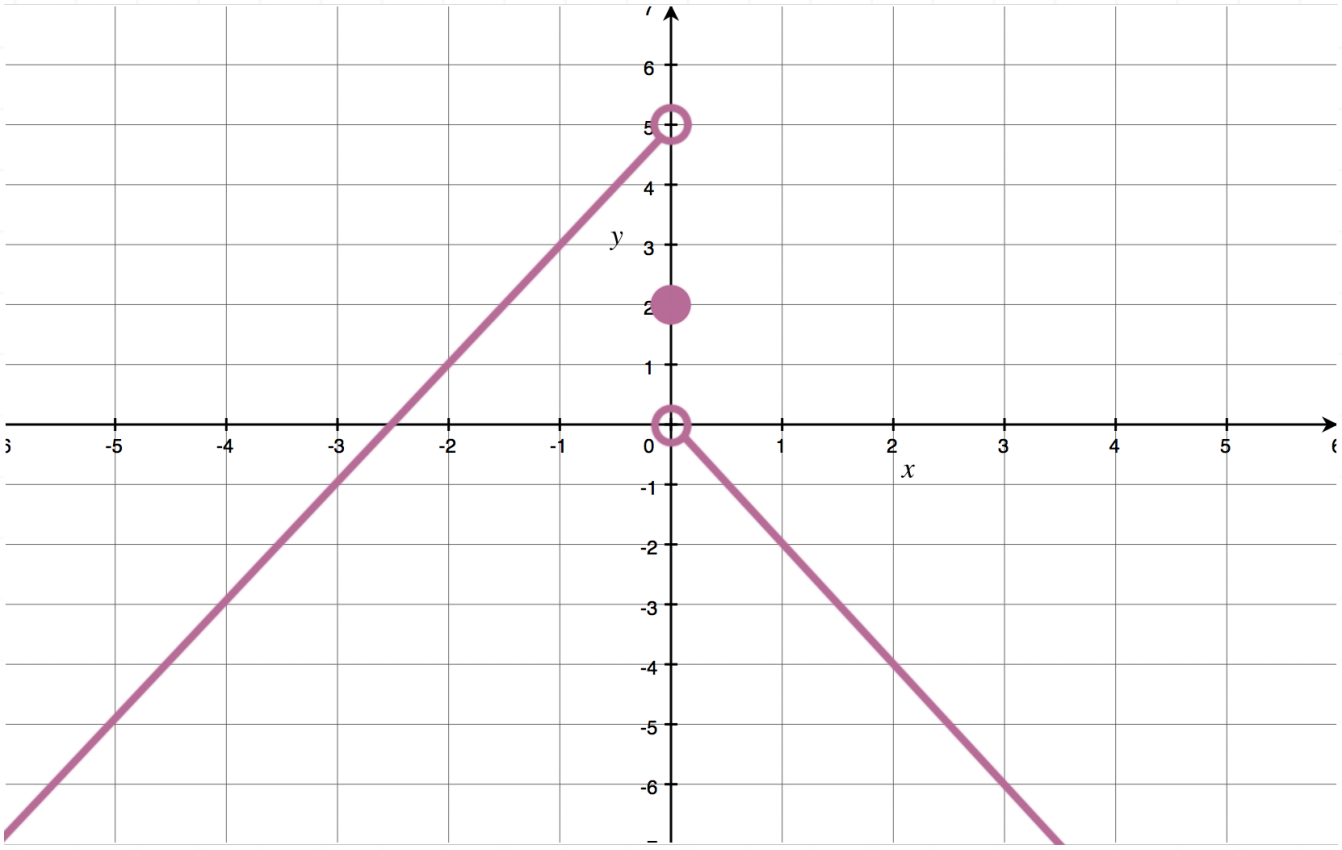
6. What are the $x$-values where the graph of $h(x)$, shown below, has jump discontinuities?

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## INFINITE/ESSENTIAL DISCONTINUITIES

■ 1. At what $x$-values does the function have infinite discontinuities?

$$f(x) = \frac{x^2 + x - 12}{x^2 + x - 2}$$

■ 2. Where are the infinite discontinuities of the function?

$$h(x) = \frac{x^4 + 3x^3 - 8x - 24}{x^2 + 3x - 4}$$

■ 3. At what $x$-values does the function have infinite discontinuities?

$$g(x) = \frac{x^2 - 5x + 6}{x^2 - 1}$$

■ 4. Where are the infinite discontinuities of the function?

$$h(x) = \frac{x^2 - 6x + 9}{x^2 - 4}$$

■ 5. At what $x$-values does the function have infinite discontinuities?

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$$h(x) = \frac{x^2 - 15x + 21}{x^2 - x - 12}$$

6. Where are the infinite discontinuities of the function?

$$g(x) = \frac{x^3 + 4x^2 - 20x - 48}{x^2 + 2x - 8}$$

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## ENDPOINT DISCONTINUITIES

■ 1. What is the value of the limit on the interval $[0,3]$?

$$\lim_{x\to 3} -\sqrt{x+5}$$

■ 2. What is the value of the limit on the interval $[\pi,2\pi]$?

$$\lim_{x\to \pi} \sin x$$

■ 3. What is the value of the limit on the interval $(-\infty,2]$.

$$\lim_{x\to 2} x^3 - x^2 + 4$$

■ 4. What is the value of the limit on the interval $[4,\infty)$?

$$\lim_{x\to 4} -\frac{x+7}{x^2-6x+15}$$

■ 5. What is the value of the limit on the interval $[-9/2,5/2]$?

$$\lim_{x\to \frac{5}{2}} \frac{x+3}{x^2+x+1}$$

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6. What is the value of the limit on the interval $(-2,2]$?

$$\lim_{x\to -2} \sqrt{2x+4}$$

7. What is the value of the limit on the interval $[-\pi, \pi]$?

$$\lim_{x\to \pi} -\frac{5\cos x}{2}$$

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